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United States Patent [19]

Kamase

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[54] **DOUBLE BALANCED MIXER CIRCUIT WITH LESS POWER CONSUMPTION**

[76] Inventor: **Fumihiro Kamase**, c/o NEC Corporation, 7-1 Shiba 5-chome, Minato-ku, Tokyo, Japan

[21] Appl. No.: **718,176**

[22] Filed: **Sep. 19, 1996**

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[6] **H04B 1/28**

[52] **U.S. Cl.** **455/326**; 455/333; 327/359

[58] **Field of Search** 455/323, 325, 455/326, 327, 330, 333, 317, 318, 319, 118, 119; 327/113, 355, 356, 357, 359

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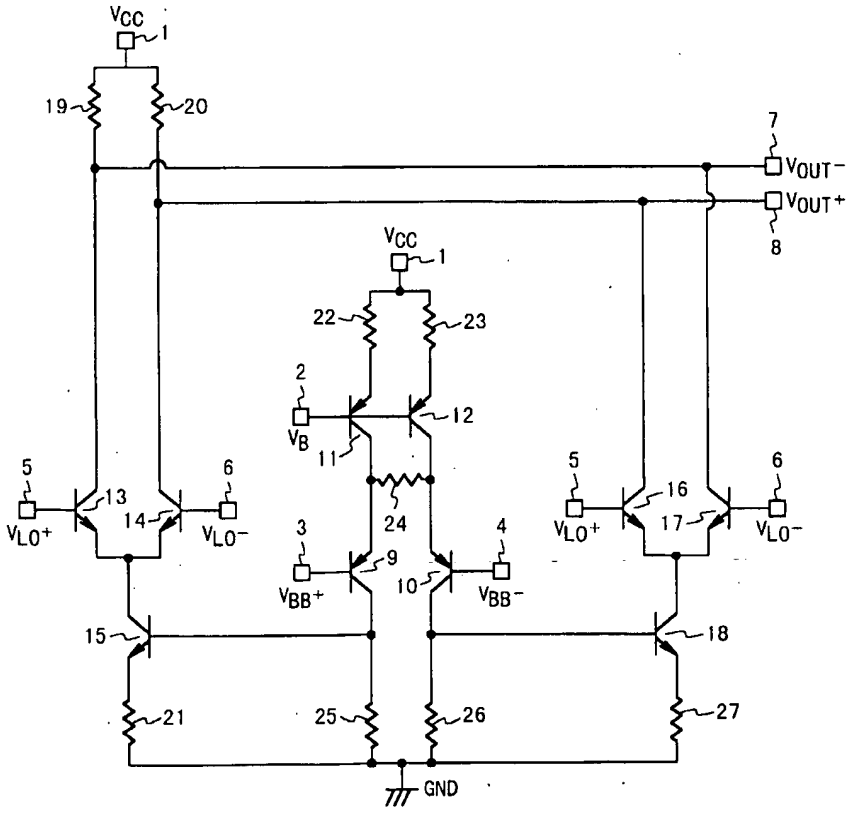
[57] **ABSTRACT**

A double balanced mixer circuit of reduced power consumption includes two single balanced mixer circuits each of which has a pair of first transistors. Output side terminals of the first transistors are cross-coupled between the two pairs, and first differential signals are supplied to control terminals of the first transistors. Connected in series to each pair of first transistors is a second transistor of a pair of second transistors. The double balanced mixer circuit also includes a differential amplifier circuit including a pair of third transistors, with fourth transistors connected to the pair of third transistors. The fourth transistors function as constant current sources for the pair of third transistors. Second differential signals are supplied to control terminals of the third transistors and differential output terminals of the third transistors are directly coupled to control terminals of the pair of second transistors.

16 Claims, 5 Drawing Sheets



US005933771A

United States Patent [19]

Tiller et al.

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[54] **LOW VOLTAGE GAIN CONTROLLED MIXER**

[75] Inventors: **Samuel Alfred Tiller**; **George Khoury**, both of Ottawa, Canada

[73] Assignee: **Nortel Networks Corporation**, Montreal, Canada

[21] Appl. No.: **08/879,771**

[22] Filed: **Jun. 20, 1997**

[51] **Int. Cl.**[6] **H04B 1/26**; H03F 3/00

[52] **U.S. Cl.** **455/333**; 455/323; 455/326; 330/254

[58] **Field of Search** 455/333, 326, 455/250.1, 323, 330, 254, 313; 327/355, 359, 113; 330/254, 252

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Primary Examiner—Reinhard J. Esenzope
Assistant Examiner—Duc Nguyen

[57] **ABSTRACT**

The functionality of a variable gain controlled amplifier and a tree mixer are combined to provide a variable gain controlled mixer. In constructing the combination, both the current-to-voltage conversion output stage of the mixer, and the voltage-to-current conversion input stage of the variable gain amplifier are removed. Both the variable gain stage and the mixing stage are connected in parallel to modify the input current. Other configurations are provided, including a single balanced mixer, and a folded mixer.

21 Claims, 10 Drawing Sheets